

## **REMARKS**

Claims 2, 6, 9, 21, 23 and 26-29 are pending in this application.

### **I. Claim Rejections Under 35 U.S.C. § 103**

#### **A. Shaw et al., Takuya et al. and Lessing**

The Examiner rejects claims 21 and 2 under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. (US 5,330,701) in view of Takuya et al. (JP 02-141402) and further modified by Lessing (US 5,496,655). Applicants respectfully traverse the rejection.

Shaw et al. disclose a  $\text{Ni}_3\text{Al}$  powder. However, the reference does not disclose or suggest that the  $\text{Ni}_3\text{Al}$  powder could have the effect of increasing the reaction speed of a catalytic reaction, and does not disclose or suggest the use of the  $\text{Ni}_3\text{Al}$  powder in a methanol-reforming reaction.

Takuya et al. disclose the use of an Al-containing metal member, as processed, to carry a Ni-Cu alloy or a Ni-Zn alloy, in a methanol-reforming reaction. However, the reference does not disclose or suggest the use of a Ni-Al alloy in a methanol-reforming reaction.

Lessing discloses a  $\text{Ni}_3\text{Al}$  compound having catalytic activity. However, the disclosed catalytic activity is for a steam reforming reaction of a hydrocarbon. The reference does not disclose or suggest the catalytic activity for a methanol-reforming reaction.

The Examiner states, "It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the method of producing hydrogen of Takuya [et al.] with the compound of Shaw [et al.] in order to increase the reforming reaction rate for methanol and further, as Lessing teaches the  $\text{Ni}_3\text{Al}$  intermetallic material being used as a catalyst for methane reformation, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize a similar material for a similar purpose" (see page 3, 2<sup>nd</sup> paragraph of the Office Action).

According to the Examination Guidelines for Determining Obviousness Under 35 U.S.C. § 103(a), as stated in MPEP 2143, the key to supporting any rejection under § 103(a) is the clear articulation of the reason(s) why the claimed invention would have been obvious. In the present case, the Examiner appears to be relying on the rationale of "[c]ombining prior art elements according to known methods to yield predictable results," because the Examiner combines the elements of Shaw et al., Takuya et al. and Lessing (see MPEP 2143, Exemplary Rationale (A)).

To reject a claim based on this rationale, the Examiner must (1) find that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference; (2) find that one of ordinary skill in the art could have combined the elements as claimed by known methods, and that in combination, each element merely performs the same function as it does separately; **(3) find that one of ordinary skill in the art would have recognized that the results of the combination were predictable;** and (4) whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness (see MPEP 2143A).

Accordingly, the mere fact that references can be combined or modified does not render the resultant combination obvious **unless the results would have been predictable** to one of ordinary skill in the art (see MPEP 2143.01.III., citing *KSR International Co. v. Teleflex Inc.* (2007)).

**The Examiner admits that the catalytic activity of a reaction system is not predictable,** but she asserts that additional evidence is required to prove that  $\text{NiAl}_3$  would not work as the Ni and Al containing catalyst of Takuya et al. (see page 10, lines 11-19 of the Office Action).

**Because the Examiner admits that the catalytic activity of a reaction system is not predictable, the Examiner has failed to establish a *prima facie* case of obviousness and the rejection should be withdrawn.**

However, Applicants submit the following further remarks and the enclosed Declaration under 37 CFR 1.132 by the first named inventor, which confirms that  $\text{NiAl}_3$  would not be sufficient as the Ni and Al containing catalyst of Takuya et al., and further confirms the unpredictability of catalytic activity in a reaction system and the unpredictability of  $\text{NiAl}_3$  as a catalyst in a reaction system.

As discussed in the Experimental section of the Declaration, a Takuya et al. specimen and a  $\text{Ni}_3\text{Al}$  cold-rolled foil specimen were each produced and evaluated for their catalytic activity in a steam reforming reaction of a hydrocarbon. The  $\text{Ni}_3\text{Al}$  cold-rolled foil specimen demonstrated an  $\text{H}_2$  generation rate of 8400 (ml/min/m<sup>2</sup>) at 900°C, and this confirmed that the specimen has high catalytic activity. On the other hand, the Takuya et al. specimen was evaluated under the

same conditions as the Ni<sub>3</sub>Al cold-rolled foil specimen, and the H<sub>2</sub> generation rate was only 1200 (ml/min/m<sup>2</sup>) at 900°C. As a result, the catalytic activity was remarkably lower in the Takuya et al. specimen than in the Ni<sub>3</sub>Al cold-rolled foil specimen.

**These results demonstrate that the Takuya et al. specimen does not have the same catalytic activity in the steam reforming reaction of a hydrocarbon as it has in the methanol-reforming reaction.** Therefore, one skilled in the art would not have found it predictable that applying a compound exhibiting catalytic activity effective to a specific reaction system (e.g., a methanol-reforming reaction) to a different reaction system (e.g., a hydrocarbon reforming reaction) would also exhibit catalytic activity in the different reaction system.

In addition, as explained in the Crystal Structure section of the Declaration, in Ni-Al alloys, other than a Ni<sub>3</sub>Al alloy, the Ni atoms and Al atoms are distributed irregularly and randomly, and they do not have an ordered structure like a Ni<sub>3</sub>Al alloy. This different crystal structure leads to different physical and chemical properties.

The Examples in the present specification confirm that the catalytic properties of Ni<sub>3</sub>Al are different from the catalytic properties of other Ni-Al alloys. Fig. 1 shows the differences in catalytic activity of Ni<sub>3</sub>Al and Raney Ni (through hydrogen generation rates) for a methanol-reforming reaction. At a temperature of not less than 300°C, Ni<sub>3</sub>Al has a higher hydrogen generation rate than Raney Ni. In addition, Figs. 4-5 show the differences in catalytic properties of a several Ni-Al alloys of different compositions in a methanol-reforming reaction. Thus, the catalytic properties are not the same for all Ni-Al alloys.

Therefore, one skilled in the art would not have found it predictable to apply a compound exhibiting catalytic activity effective in a specific reaction system (e.g., a hydrocarbon reforming reaction) to a different reaction system (e.g., a methanol-reforming reaction) to also exhibit catalytic activity in the different reaction system. Accordingly, one skilled in the art would not have predicted that applying the Ni<sub>3</sub>Al of Lessing to the methanol-reforming reaction of Takuya et al. would result in a high catalytic activity in the methanol-reforming reaction with a reasonable expectation of success.

Therefore, there would have been no reasonable expectation of success of arriving at the claimed invention in view of Shaw et al., Takuya et al. and Lessing.

Thus, claim 21 would not have been obvious over the references.

Claim 2 depends directly claim 21, and thus also would not have been obvious over the references.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

**B. Shaw et al., Takuya et al., Lessing and Fukui et al.**

The Examiner rejects claim 9 under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. as modified by Takuya et al. and by Lessing, as applied to claim 21 above, and further in view of Fukui et al. (US 5,635,439). Applicants respectfully traverse the rejection.

As discussed above, there would have been no reasonable expectation of success of arriving at the methanol-reforming method of claim 21 in view of Shaw et al., Takuya et al. and Lessing.

Fukui et al. do not teach or suggest the methanol-reforming method of claim 21, and provide no reasonable expectation of success of arriving at the claimed invention.

Therefore, claim 21 would not have been obvious over the references.

Claim 9 depends from claim 21, and thus also would not have been obvious over the references.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

**C. Shaw et al., Takuya et al., Lessing and Makoto et al.**

The Examiner rejects claim 28 under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. as modified by Takuya et al. and by Lessing, as applied to claim 21 above, and further in view of Makoto et al. (JP 63-20973). Applicants respectfully traverse the rejection.

As discussed above, there would have been no reasonable expectation of success of arriving at the methanol-reforming method of claim 21 in view of Shaw et al., Takuya et al. and Lessing.

Makoto et al. do not teach or suggest the methanol-reforming method of claim 21, and provide no reasonable expectation of success of arriving at the claimed invention.

Therefore, claim 21 would not have been obvious over the references.

Claim 28 depends from claim 21, and thus also would not have been obvious over the references.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

**D. Shaw et al., Lashmore et al., Coll et al. and Takuya et al.**

The Examiner rejects claims 23, 6 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. as modified by Lashmore et al. (US 2008/0014431) and by Coll et al. (US 2003/0042226), and further in view of Takuya et al.

The arguments above regarding Shaw et al. and Takuya et al. are also applicable to this rejection, because claim 23 is directed to a methanol-reforming method which comprises producing hydrogen by bringing methanol or a liquid mixture of methanol and water into contact with a catalyst comprising an intermetallic compound  $\text{Ni}_3\text{Al}$ .

The Examiner asserts that it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the method of producing hydrogen of Takuya et al. with the compound of Shaw et al. as modified by Lashmore et al. in order to increase the reforming reaction rate for methanol (see page 6, 2<sup>nd</sup> paragraph).

However, as discussed above, one skilled in the art would not have found it predictable that applying a compound exhibiting catalytic activity effective to a specific reaction system (e.g., a methanol-reforming reaction) to a different reaction system (e.g., a hydrocarbon reforming reaction) would also exhibit catalytic activity in the different reaction system. Consequently, there would have been no reasonable expectation of success to one of ordinary skill in the art that using the  $\text{Ni}_3\text{Al}$  powder disclosed in Shaw et al. with the Al-containing metal member used in the methanol-reforming reaction disclosed in Takuya et al. would increase methanol-reforming reactivity.

Lashmore et al. and Coll et al. do not teach or suggest the methanol-reforming method of claim 23.

Therefore, claim 23 would not have been obvious over the references.

Claims 6 and 26 depend directly from claim 23, and thus also would not have been obvious over the references.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

**E. Shaw et al., Lashmore et al., Coll et al., Takuya et al. and Fukui et al.**

The Examiner rejects claim 27 under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. as modified by Lashmore et al. and by Coll et al. and further in view of Takuya et al., as applied to claim 23 above, and further modified by Fukui et al.

As discussed above, there would have been no reasonable expectation of success of arriving at the methanol-reforming method of claim 23 in view of Shaw et al., Lashmore et al., Coll et al. and Takuya et al.

Fukui et al. do not teach or suggest the methanol-reforming method of claim 23, and provide no reasonable expectation of success of arriving at the claimed invention.

Therefore, claim 23 would not have been obvious over the references.

Claim 27 depends from claim 23, and thus also would not have been obvious over the references.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

**F. Shaw et al., Lashmore et al., Coll et al., Takuya et al. and Mokota et al.**

The Examiner rejects claim 29 under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. as modified by Lashmore et al. and by Coll et al. and further in view of Takuya et al., as applied to claim 23 above, and further modified by Makoto et al.

As discussed above, there would have been no reasonable expectation of success of arriving at the methanol-reforming method of claim 23 in view of Shaw et al., Lashmore et al., Coll et al. and Takuya et al.

Makoto et al. not teach or suggest the methanol-reforming method of claim 23, and provide no reasonable expectation of success of arriving at the claimed invention.

Therefore, claim 23 would not have been obvious over the references.

Claim 29 depends from claim 23, and thus also would not have been obvious over the references.

Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

## II. Conclusion

For these reasons, Applicants take the position that the presently claimed invention is clearly patentable over the applied references.

Therefore, in view of the foregoing remarks, it is submitted that the rejections set forth by the Examiner have been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

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Attachment: Declaration Under 37 C.F.R. § 1.132